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EFFECTS OF SIZE AND SHAPE OF INERT PADS ON HEP SHELL PERFORMANCE (U)

ROBERT J. HEREDIA
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APRIL 1959



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PICATINNY ARSENAL
DOVER, N. J.

ORDNANCE PROJECT TW-426, ITEM U
DEPT. OF THE ARMY PROJECT 5A04-01-001

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PERFORMANCE (U)

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J.;

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COUNTERMEASURES, EFFECTIVENESS, IMPACT SHOCK, LOADING,
PROJECTILES (M)

IDENTIFIERS: 90-MM ORDNANCE ITEMS, T-142
CARTRIDGES(90-MM) (M)

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April 1959

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Picotinny Arsenal
Dover, N. J.

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Technical Report 2611

Ordnance Project TW-426, Item u

Dept of the Army Project 5A04-01-001

Approved:

L. H. Eriksen

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(U) OBJECT

To determine the effect of various thicknesses of inert nose pads and sidewall pads on the performance of Composition A-3 loaded HEP shell.

(C) SUMMARY

(C) From the results of earlier tests of HEP shell bursting charges, three facts stood out:

1. Introduction of inert nose pads was the most outstanding advance in HEP charge design.
2. Composition A-3 with inert nose pad was the best charge that had been tested.
3. Performance at 60° obliquity was unsatisfactory.

(U) The investigation covered by this report was directed toward optimizing inert pad design, while possibly improving 60° obliquity performance by using sidewall pads. Composition A-3 loaded 90 mm T142E3 HEP-T shell containing three heights of nose pad ($\frac{1}{2}$, $1\frac{1}{2}$, and $2\frac{1}{2}$ inches) and three conditions of sidewall pad ($\frac{1}{4}$ - and $\frac{3}{8}$ -inch nominal thickness, and none) were fired against 4-inch armor plate.

(C) At 60° obliquity and 1800 fps, none of 6 shell containing sidewall pads produced spalls, while 4 out of 4 containing only nose pads produced spalls. At 0° obliquity and 1800 fps, 8 out of 9 shell spalled armor plate. Five of the

6 lots from which these 9 shell were taken contained sidewall pads. The maximum striking velocities at which consistent spalling occurred were 2700 fps at 0° obliquity and 2600 fps at 60° obliquity. In both of these instances, the shell contained $\frac{1}{2}$ -inch-high nose pads. The decrease in effectiveness at 60° obliquity associated with use of sidewall pads is attributed to the lack of sufficient explosive between the fuze and the armor plate.

(C) CONCLUSIONS

Of the inert pad designs tested, the $\frac{1}{2}$ -inch-high nose pad with no sidewall pad is best. This nose pad provides sufficient protection against deflagration at impact velocities of up to 2700 fps.

Performance at 60° obliquity could best be improved by using a more powerful explosive in conjunction with an inert nose pad.

(C) RECOMMENDATIONS

For HEP shell designed for velocities of up to 2700 fps, inert nose pads $\frac{1}{2}$ -inch high should be incorporated in the charge design.

More powerful explosives, such as 91/9 HMX/desensitizer, should be tested with inert nose pads as HEP shell bursting charges.

(C) INTRODUCTION

(C) 1. The overall objective of development work on HEP shell bursting charges is to obtain a charge which can (a) defeat the required thickness of armor for its caliber, (b) be capable of such performance at high impact velocities and at all obliquities ranging from 0° (normal incidence) to 60° obliquity, and (c) be suitable for mass production. In the many and varied tests of HEP shell bursting charges that have been conducted (Refs 1 and 2), Composition A-3 with an inert nose pad has been found to be the best of all charges tested. Use of the inert nose pad has raised the approximate maximum velocity at which these shell can defeat armor plate from 2000 fps to 2800 fps.

(C) 2. Early attempts to reduce cost and increase output by loading HEP shell with castable charges were unsuccessful. The shell could not defeat armor plate except at velocity levels which were too low to be useful. At the higher velocities, they deflagrated upon impact. Because the introduction of a nose pad, together with improved, faster fuzing had prevented the deflagration of Composition A-3-loaded shell at striking velocities of up to 2800 fps, it was decided that the effect of these improvements on cast-loaded shell should be investigated.

(C) 3. Accordingly, the effect of the nose pad and improved fuzing on HEP performance of Composition B, cyclotol, and octol was investigated (Ref 7). Although some improvement was obtained, none of these cast-loaded explosives

were as effective as Composition A-3. It was noted that, throughout these tests, the 60° obliquity performance was very poor. It was postulated that this may have been caused by the absence of any inert pad protection for the shell sidewalls.

(U) 4. The greatest improvement to date in HEP shell performance has been obtained by the use of inert nose pads. The size and shape of the pads used previously had been arbitrarily selected. Therefore, a firing program was designed with the objective of improving inert pad design. This program also included an attempt to improve 60° obliquity performance by the use of inert sidewall pads. Tests were to be conducted with 90 mm T142E3 HEP-T shell at striking velocities of between 1800 fps and 2800 fps and at both 0° and 60° obliquity. The shell would contain Composition A-3 with three heights of nose pad ($\frac{1}{2}$, $1\frac{1}{2}$, and $2\frac{1}{2}$ inches) and three conditions of sidewall pad (none, $\frac{1}{4}$ -inch nominal thickness, and $\frac{3}{4}$ -inch nominal thickness). The sidewall pads were to extend approximately eight inches backward from the shell nose. The results are given in this report.

(C) RESULTS

(U) 5. Nine experimental lots of T142E3 shell were loaded with Composition A-3 containing various heights of inert nose pads and various thicknesses (nominal) of inert sidewall pads. The shell were tested at velocities ranging from 1800 fps to 2900 fps against 4-inch armor plate at both 0° and 60° obliquity.

The results of these tests are summarized in Tables 1 and 2 below, and Table 3 (p 4).

Detailed data is given in Tables 4, 5, and 6 (pp 9, 10, and 11) and Figure 5 (p 16).

TABLE 1

Firing Results for Shell Containing 1/2-Inch Nose Pads

Striking Velocity, fps	Number of Spalls/Number of Rounds Fired					
	No Sidewall Pad		1/4-Inch Pad		3/8-Inch Pad	
	0°	60°	0°	60°	0°	60°
2900			0/2 ^a			
2800	0/1	0/2	1/1	0/1	0/1	0/1
2700		1/4	5/5			
2600		5/7	2/3 ^b			
2400		1/1				
2300		1/1				
2000		1/1				

^a These shell detonated apparent low order, with no fuze functioning time recorded.

^b For the shell in this group which did not spall, footnote a applies.

TABLE 2

Firing Results for Shell Containing 1 1/2-Inch Nose Pads

Striking Velocity, fps	Number of Spalls/Number of Rounds Fired					
	No Sidewall Pad		1/4-Inch Pad		3/8-Inch Pad	
	0°	60°	0°	60°	0°	60°
2800	0/1 ^a	0/3	0/1 ^a	0/1	0/1 ^b	0/1
2700			1/3 ^c			
2600		0/2	4/5			
2500		0/2				
2400		2/5				
2300		2/5				
1900					0/1	
1800	1/1	1/1	1/1	0/1		0/1

^a This shell did not explode; a definite fuze failure.

^b This shell detonated apparent low order, with no fuze functioning time recorded.

^c One of the two shell which did not produce a spall was a fuze failure as in a above.

TABLE 3
Firing Results for Shell Containing 2½-Inch Nose Pads

Striking Velocity, fps	Number of Spalls/Number of Rounds Fired					
	No Sidewall Pad		¼-Inch Pad		⅜-Inch Pad	
	0°	60°	0°	60°	0°	60°
2800	0/1 ^a	0/3	1/1	0/1	0/1 ^a	0/1
2700		1/4	2/3			
2600		0/2	5/5			
2500		0/2				
2400		1/3				
2300		1/2				
1900			1/1			
1800	1/1	1/1		0/1	1/1	0/1

^a This shell did not explode; a definite fuze failure.

(C) DISCUSSION OF RESULTS

(C) 6. The first firings under this program were conducted at 1800 fps to determine performance at long range and at 2800 fps to determine performance at short range. At 1800 fps and 60° obliquity, none of the 6 shell which contained sidewall pads produced spalls, while 4 out of 4 containing only nose pads did produce spalls. This clearly showed that, instead of improving performance at 60° obliquity, the presence of the sidewall pad distinctly degrades high obliquity HEP shell performance. This is probably because, at 60° obliquity, the shell containing the sidewall pads did not have a sufficient amount of explosive between the armor plate and the fuze.

(C) 7. However, at 0° obliquity and 1800 fps to 1900 fps, 8 out of 9 shell

tested produced spalls, including 5 out of 6 containing sidewall pads. This tends to indicate that it is the height of the explosive between fuze and armor plate that is critical, because at 60° obliquity there is only one-half as much explosive height between the fuze and the armor plate as there is at 0° obliquity, assuming equal fuze functioning time and shell velocity.

(C) 8. At 2800 fps and 60° obliquity, none of the shell tested produced spalls. Only 2 out of 9 shell tested at 0° obliquity and 2800 fps produced spalls. The 2 spalls were produced by shell having ½-inch-thick sidewall pads, one each having the ½-inch and 2½-inch high nose pads. Of the 7 failures, 4 were duds, that is, the fuze did not function, and the remaining 3 may be considered to have deflagrated before the fuze could

function. Although these 3 failures appear to have occurred because the protection provided by the inert nose pads was insufficient to prevent shock initiation before fuze action (2 of these rounds had only $\frac{1}{2}$ -inch-high nose pads and the third had a $1\frac{1}{2}$ -inch-high nose pad), it does not necessarily follow that a thicker inert pad is needed to insure against shock initiation before fuze action at 2800 fps and 0° obliquity.

(C) 9. The fact that no functioning times were recorded for these 3 shell and that 4 other shell fired at 0° and 2800 fps were fuze duds indicates that the fuzes used were too slow for 2800 fps and 0° obliquity. Thus, had faster fuzes been available and employed, fuze action might very well have taken place before shock initiation. Moreover, the 2 shell which did produce spalls under these conditions had a mean functioning time of 334 microseconds. If it is assumed that no crush-up deceleration takes place, this would mean that at 2800 fps, 11.2 inches of crush-up would take place before the fuze could function (2800 feet per second \times 12 inches per foot $\times 10^{-6}$ seconds per microsecond \times 334 microseconds). It is recognized, of course, that some crush-up deceleration does take place. If it did not, the 2 shell which produced spalls could not have done so, since the distance between the nose of the shell and the fuze is only about 11.3 inches. However, when a 90 mm HEP shell impacts 4-inch armor plate at 2800 fps with a fuze which requires about 330 microseconds to function, we are probably quite close

to the point at which the height of the explosive between the fuze and the armor plate is insufficient to spall the armor.

(C) 10. Also of interest is the fact that, of the 3 shell containing $\frac{1}{4}$ -inch-thick sidewall pads that impacted at 2800 fps and 0° obliquity, none deflagrated. Two produced spalls and one was a fuze dud. This was in contrast to the performance of shell containing no sidewall pad (2 fuze duds and 1 deflagration out of 3 attempts) and of shell containing the $\frac{3}{4}$ -inch-thick sidewall pad (1 fuze dud and 2 deflagrations out of 3 attempts). It may be that the forward portion of the $\frac{1}{2}$ -inch-thick sidewall pad helped delay deflagration until fuze action took place. This hypothesis is very tenuous, however, because the amount of data available is so limited. If any deduction could be made, it would be that a crescent may be the optimum sectional shape for the inert nose pad. Supporting this concept is the work reported in References 1 and 2, wherein deflagration was avoided in the 76 mm T170E3 HEP-T shell at velocities of up to 3000 fps by using pressed nose pads whose cross section was crescent-shaped.

(C) 11. The remaining tests to determine the relative merits of $\frac{1}{2}$ -inch, $1\frac{1}{2}$ -inch, and $2\frac{1}{2}$ -inch nose pads were conducted at 60° obliquity with shell containing no sidewall pads and at 0° obliquity with shell having sidewall pads. This was done because, as is discussed in paragraphs 6 and 7, it had been determined that the presence of a sidewall pad was undesirable at 60° obliquity but not at 0° obliquity, and also because

the supply of shell having no sidewall pads was limited.

(C) 12. At 0° obliquity and velocities of up to 2600 fps, no significant difference was found among the three different nose pad thicknesses. However, at 2700 fps, shell containing the 2½-inch-high nose pad produced spalls only twice in 3 trials and those containing the 1½-inch-high nose pad only once in 2 trials, discounting 1 fuze dud. On the other hand, shell containing the ½-inch-high nose pad successfully spalled the armor plate in 5 out of 5 trials. The same trend was much more evident in the 60° obliquity tests, where the shell containing ½-inch-high nose pads and no sidewall pad were successful in 5 out of 7 trials at 2600 fps, while the best the other types could produce was 2 spalls out of 5 trials at 2400 fps for the 1½-inch-high nose pad and, at the same velocity, only 1 spall in 4 trials for the 2½-inch-high nose pad. Thus it appears that the ½-inch-high nose pad, without any sidewall pad, is superior under the conditions of this test to all other inert pad designs tested.

(C) 13. It appears that up to 2700 fps, ½-inch-high inert nose pads are sufficient to prevent deflagration, and that increasing the amount of inert material in the nose of the shell decreases the ability of the shell to defeat the target armor plate at velocities of 2300 fps and greater, especially at 60° obliquity. This indicates that when a HEP shell strikes an armor plate target, at least a major part of the forward or nose end

portion of the bursting charge remains between the armor and the fuze until the fuze detonates.

(C) 14. Another aspect of the data which emphasizes the degradation effected by the introduction of sidewall pads is the volume of metal spalled off the rear of the target plate. For shell containing no sidewall pads, the maximum dimensions of the average spall hole in inches were: 1.17 deep × 8.14 wide × 6.66 high, while, for shell containing ¼-inch-thick sidewall pad, the dimensions were .57 deep × 7.03 wide × 7.39 high. If these values are multiplied to obtain volumes, values of 63.6 for the no-sidewall pad condition and 29.5 for the ¼-inch-sidewall pad condition are obtained.

(C) 15. This increase of over 100% from the ¼-inch-sidewall pad to the no-sidewall pad is even more significant when it is remembered that the great majority of shell containing ¼-inch-sidewall pad were fired at 0° obliquity, which is much more favorable for spalling than the 60° obliquity at which the great majority of shell containing no sidewall pads were fired. No similar comparison may be made with validity for the ¾-inch-sidewall pad, since the total numbers of spalls obtained were 22 for the no-sidewall-pad shell, 24 for the ¼-inch-sidewall-pad shell, but only 2 for the ¾-inch-sidewall-pad shell.

(U) 16. Overall, the results indicate that the most critical aspect of HEP shell performance, once deflagration has been eliminated by use of an inert nose pad and proper fuzing, is the amount of

explosive on the plate when the fuze functions, especially with regard to the height of the explosive. This is in agreement with the results of work reported in Reference 4.

(C) 17. Improvement in performance at 60° obliquity could probably be achieved by using more powerful explosives than Composition A-3, perhaps based on HMX rather than RDX. Satisfactory performance (spalling) might then be obtained with smaller quantities (or heights) of explosive on the plate when the fuze functioned. A bursting charge which may provide considerable improvement in performance is the HMX analog of Composition A-3, 91/9 HMX/desensitizer, used in conjunction with an inert nose pad. In tests conducted with 75 mm T165E11 HEP-T shell containing 91/9 HMX/desensitizer without an inert nose pad (Ref 5), consistent spalling occurred at 0° obliquity and striking velocities of 1600, 1800, 2000, 2200, and 2400 fps. Under similar test conditions, shell containing Composition A-3 without an inert nose pad failed to defeat the target at 2400 fps and 0° obliquity.

(U) EXPERIMENTAL PROCEDURE

18. The following materials were used:

a. Composition A-3, conforming to Specification PA-PD-181, 9 June 1952

b. Filler E, conforming to Specification PA-PD-796, 5 January 1956.

19. The inert nose pads and sidewall pads were prepared as follows:

a. A molten mixture of 35/5/33/27 glyceride of 12-hydroxy stearic acid/wood rosin/dead-burned gypsum/iron oxide was prepared. The mixture was allowed to cool with constant stirring to 88°C and the nose and sidewall pads were cast into the shell. To control the sidewall pad thickness and the nose pad height, special fixtures (SK-56931, 1/4-inch-thick, and SK-56932, 3/8-inch-thick sidewall pad) were used. By using the appropriate adapter with the fixture, the correct nose pad height was obtained with each sidewall pad used.

20. All 180 shell were press-loaded with Composition A-3 (Lor WAD-3-114) in either 4 or 5 increments. The following increment weights were used:

Lot PA-E-	Weight of Increments, oz
25053	22, 16, 16, 16, and 7.5
25054	15, 12, 12, 10, and 9
25055	10, 12, 12, 10, and 9.5
25056	22, 16, 16, 16, and 4
25057	14, 12, 12, 10, and 8
25058	10, 12, 12, 10, and 9.5
25059	22, 16, 16, and 16
25060	15, 12, 10, 10, and 8
25061	14, 10, 10, 10, and 7

All charges were compressed at 19.3 tons (8000 psi) with a 2.040-inch-diameter punch and a dwell time of 5 seconds.

Figures 1, 2, and 3 (pp 12, 13, and 14) show the three types of shell loading used. The fuze wells of these shell were drilled as specified in Figure 4 (p 15).

21. All shell were assembled as shown in Figure 4, with M91A1 BD Mod 6 fuzes from Lot PA-E-25194. The 180 shell were then shipped to Jefferson Proving Ground where they were assembled into complete rounds with propelling charges to achieve the desired striking velocities. Results of these test firings are reported in Reference 6.

(C) REFERENCES

1. D. E. Seeger, B. A. Rausch, K. G. Sheffield, *Effect of Inert Nose Pads on Functioning of T170E3 76 mm HEP-T Shell*, Picatinny Arsenal Technical Report 2207, October 1955
2. B. A. Rausch, *Use of Inert Nose Pads and Controlled Fuzing to Improve HEP Shell Performance (C)*, Picatinny Arsenal Technical Report 2372, October 1956
3. R. J. Heredia, M. J. Margolin, *Cast-Loaded Bursting Charges for the 90 mm T142E3 HEP-T Shell*, Picatinny Arsenal Technical Report 2530, August 1958
4. Chamberlain Corporation Progress Report Nos. 16 and 17, Report of Static Firing Tests, Contract DA-11-022-501-ORD-2140, Basic HEP Development Program, September 1956 and April 1957
5. Jefferson Proving Ground Firing Record A-11428
6. Jefferson Proving Ground Firing Record A-26488
7. M. J. Margolin, *Investigation of Cast Fillers for HEP Shell*, Picatinny Arsenal Research and Development Lecture No. 57, January 1957

TABLE 4

Results^o of Firings of T142E3 HEP Shell Containing Inert Nose Pads with No Sidewall Pads Against 4-inch-thick Armor Plate

Lot PA-E-	Filler	Oblliquity, degrees	Avg Striking Velocity, fps	Spalls/Rds Fired	Avg Spall Size, in.		Avg Spall Wt, lb	Avg Fuze Functioning Time, microsec
					Depth	Hor	Vert	
25053	Comp A-3 w/ 1 1/2" nose pad	0	1800	1/1	1.13	8.50	9.00	N.R. ^g
			2800	0/1 ^b	—	—	—	406
		60	1800	2/2	1.25	8.50	6.50	360
			2000	1/1	1.25	9.00	7.00	N.R.
			2200	1/1	1.25	9.00	7.00	N.R.
			2400	1/1	1.13	9.00	6.50	8.30 ^e
			2600	5/7	1.15	7.90	5.80	7.53
			2700	1/4	1.00	7.50	6.00	N.R.
			2800	0/2	—	—	—	307
			1800	1/1	1.13	7.75	7.63	N.R.
			2800	0/1 ^c	—	—	—	399
			1800	1/1	1.25	6.00	6.50	N.R.
25056	Comp A-3 w/ 1 1/2" nose pad	0	1800	1/1	1.25	8.25	6.75	359
			2300	2/5	1.00	8.00	7.00	330
		60	2400	2/5	1.25	8.00	7.00	N.R.
			2500	0/2	—	—	—	324
			2600	0/2	—	—	—	306
			2800	0/3	—	—	—	318
			1800	1/1 ^c	—	—	—	313
			2800	0/1	1.50	7.00	7.00	N.R.
			1800	1/1	1.25	11.50	7.00	N.R.
			2300	1/2	1.00	8.00	7.00	8.70 ^d
			2400	1/3 ^f	1.25	7.50	7.00	N.R.
			2500	0/2	—	—	—	320
25059	Comp A-3 w/ 2 1/2" nose pad	0	1800	1/1	1.25	8.00	6.50	314
			2800	0/1	—	—	—	304
		60	1800	1/1	1.00	8.00	6.50	290
			2300	1/2	—	—	—	—
			2400	1/3	—	—	—	—
			2500	0/2	—	—	—	—
			2600	0/2	—	—	—	—
			2700	1/4	1.00	8.00	6.50	9.43 ^d
			2800	0/3	—	—	—	—
			1800	1/1	1.25	11.50	7.00	N.R.
			2300	1/2	1.00	8.00	7.00	8.70 ^d
			2400	1/3	1.25	7.50	7.00	N.R.

^a Results obtained from Reference 4.^b These shell detonated apparent low order, and no fuze functioning time was recorded.^c This shell did not explode; hence it was a definite fuze failure.^d Weight of 1 spall, others not recovered.^e Average of 2 spalls, other not recovered.^f One round, which struck edge of butt, was disregarded.^g N.R. means not recovered.

TABLE 5

Results^a of Firings of T142E3 HEP Shell Containing Various Heights of Inert Nose Pad and 1/2-inch-thick (nominal) Sidewall Pad Against 4-inch-thick Armor Plate

Lot PA-E-	Filler	Obliquity, degrees	Avg. Striking Velocity, fps	Spalls/Rds Fired	Depth	Avg Spall Size, in.		Avg Spall Wt, lb	Avg Fuze Functioning Time, microsec	
						Hor	Vert			
2505 ^d	Comp A-3 w/ 1 1/2" nose pad	0	1900	1/1	1.00	7.75	8.50	N.R.	408	
			2600	2/3 ^c	.50	7.25	7.38	N.R.	324	
			2700	5/5	.50	6.75	6.88	N.R.	345	
			2800	1/1 ^b	.50	6.00	6.50	N.R.	345	
			2900	0/2	—	—	—	—	—	
2507	Comp A-3 w/ 1 1/2" nose pad	60	1800	0/1	—	—	—	—	274	
			2800	0/1	—	—	—	—	289	
			1800	1/1	1.00	7.50	7.63	7.77	386	
			2600	4/5	.50	6.50	7.38	3.31 ^d	321	
			2700	1/3 ^f	.50	7.50	7.50	N.R.	306	
25060	Comp A-3 w/ 2 1/2" nose pad	60	2800	0/1 ^e	—	—	—	—	—	
			1800	0/1	—	—	—	—	365	
			2800	0/1	—	—	—	—	290	
			1900	1/1	1.00	7.50	7.75	N.R.	388	
			2600	5/5	.50	7.50	7.75	N.R.	323	
			2700	2/3	.50	7.25	7.75	N.R.	311	
			2800	1/1	.75	6.25	6.75	546	322	
			1800	0/1	—	—	—	—	359	
			2800	0/1	—	—	—	—	288	

^a Results obtained from Reference 4.^b These shell detonated, apparent low order, and no fuze functioning time was recorded.^c The shell which did not spall in this group functioned as in b above.^d Weight of 1 spall, others not recovered.^e This shell did not explode; hence, it was a definite fuze failure.^f One of the two shell which did not produce a spall was a fuze failure as in e above.

TABLE 6

Results^a of Firings of T142E3 HEP Shell Containing Various Heights of Inert Nose Pad
and $\frac{3}{8}$ -inch-thick (nominal) Sidewall Pad Against 4-inch-thick Armor Plate

Lot PA-E-	Filler	Obliquity, degrees	Avg. Striking Velocity, fps	Spalls/Rds Fired	Avg Spall Size, in.		Avg Spall Wt, lb	Avg Fuze Functioning Time, microsec	
					Depth	Hor	Vert		
25055	Comp A-3 w/ $\frac{1}{2}$ " nose pad	0	1900	1/1	1.00	7.25	8.00	N.R.	388
			2800	0/1 ^b	—	—	—	—	—
		60	1800	0/1	—	—	—	—	354
			2800	0/1	—	—	—	—	293
25058	Comp A-3 w/ $1\frac{1}{2}$ " nose pad	0	1900	0/1	—	—	—	—	395
			2800	0/1 ^b	—	—	—	—	—
		60	1800	0/1	—	—	—	—	361
			2800	0/1	—	—	—	—	289
25061	Comp A-3 w/ $2\frac{1}{2}$ " nose pad	0	1800	1/1	1.00	6.50	6.25	N.R.	394
			2800	0/1 ^c	—	—	—	—	—
		60	1800	0/1	—	—	—	—	358
			2800	0/1	—	—	—	—	291

^a Results obtained from Reference 4.

^b These shell detonated, apparent low order, and no fuze functioning time was recorded.

^c This shell did not explode; hence, it was a definite fuze failure.

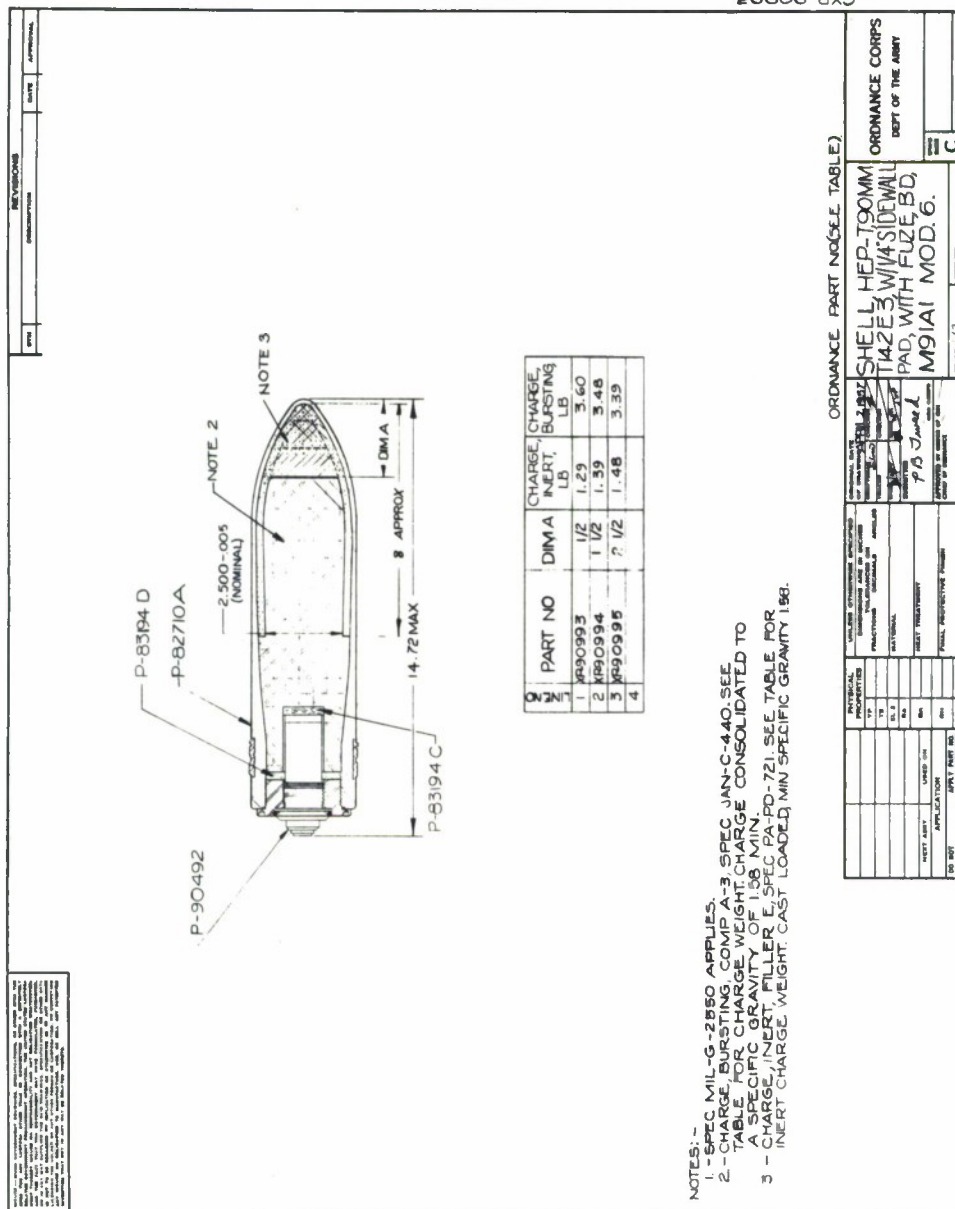


Fig 2 T142E3 HEP Shell with Nose Pad and 1/4-Inch Sidewall Pad

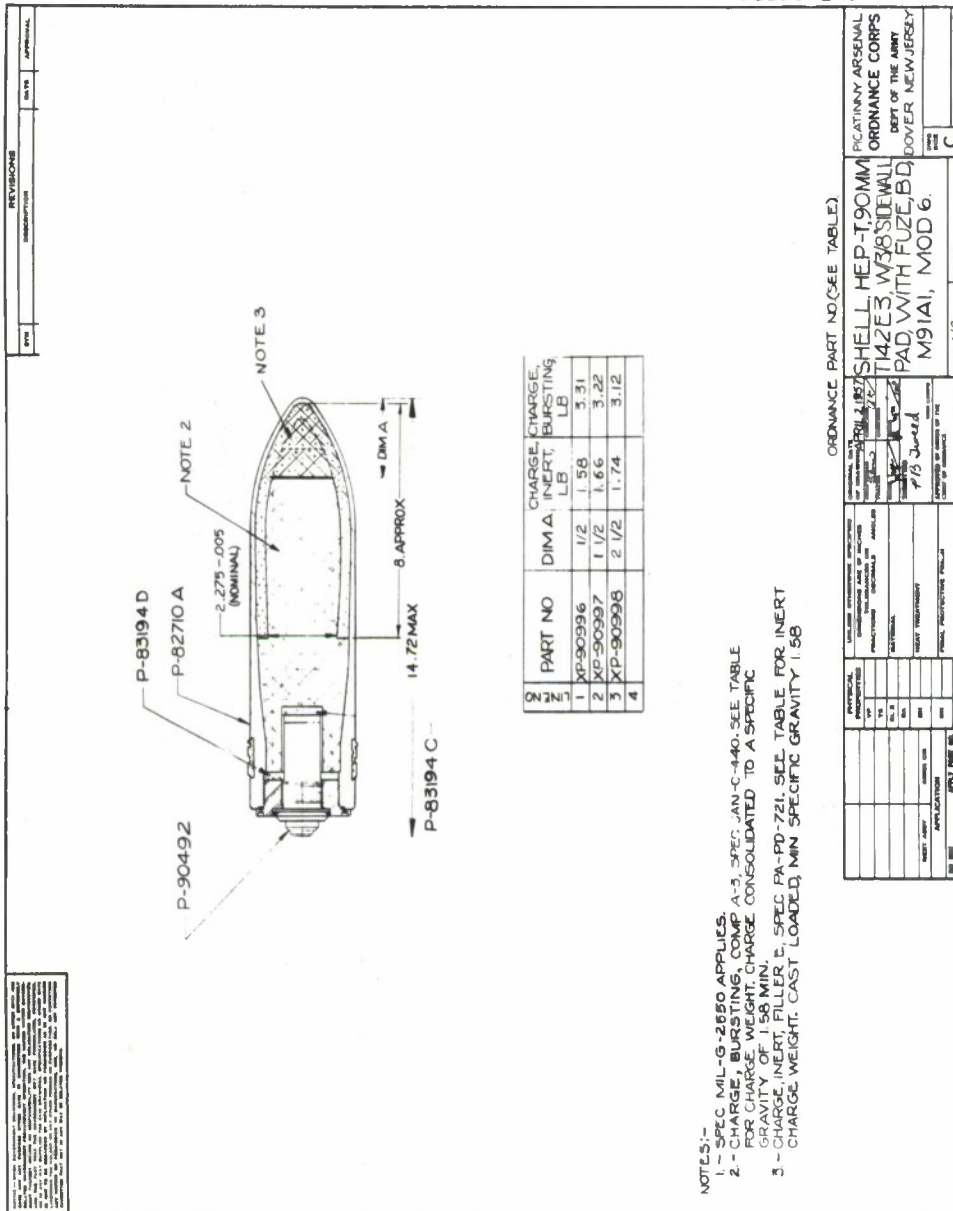


Fig 3 T142E3 HEP Shell with Nose Pad and 3/8-Inch Sidewall Pad

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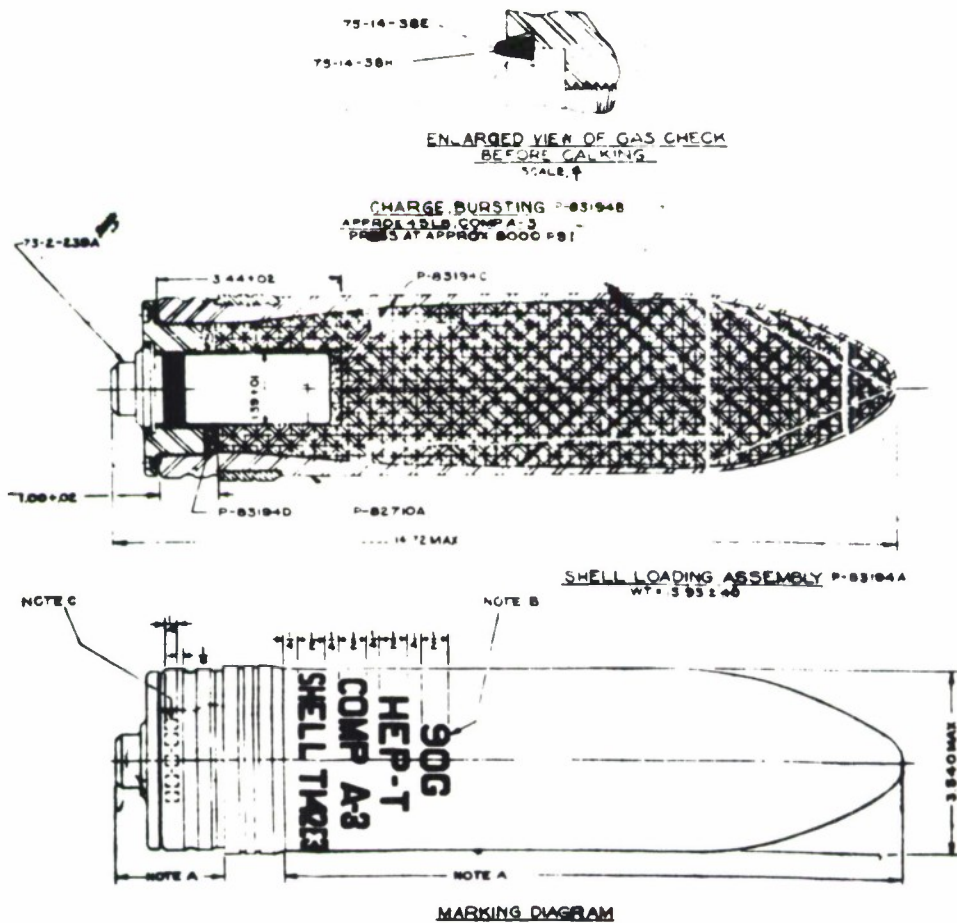


Fig 4 Loading and Marking of T142E3 Shell

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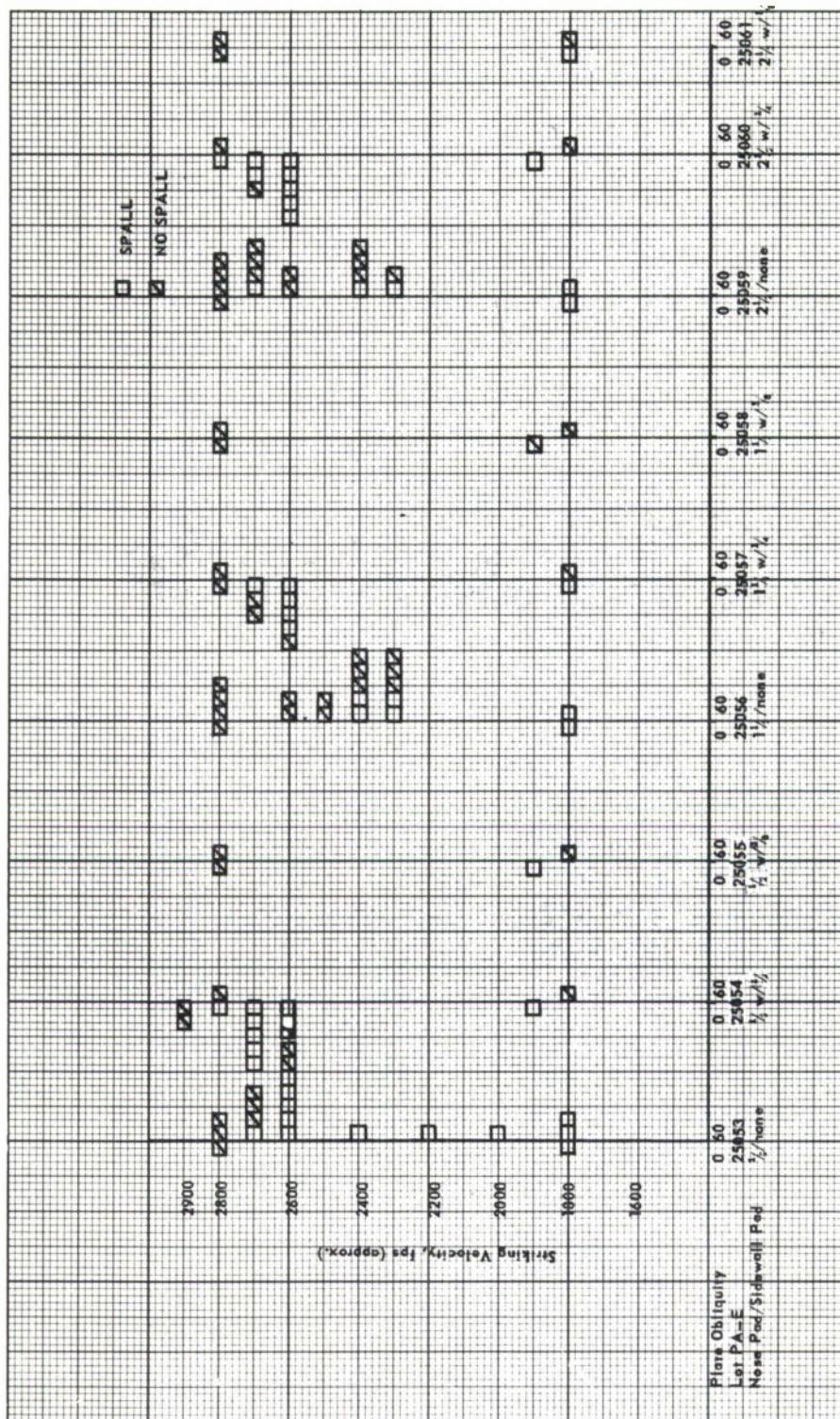


Fig 5 Firing Results for 90 mm T142E3 HEP-T Shell Containing Inert Nose and Sidewall Pads (From Ref 4)

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